DIONE'S SURFACE COMPOSITION FROM VIS-IR SPECTRAL MODELING B. Gorga[1,2], M. Ciarniello[2], G. Filacchione[2], A. Raponi[2], V. Galluzzi[2], E. D'Aversa[2]. [1]Sapienza Università di Roma, Piazzale Aldo Moro, 5, 00185 Rome, IT (beatrice.gorga@inaf.it), [2]INAF-IAPS, via del Fosso del Cavaliere, 100, 00133, Rome, IT.

Introduction: Cassini-Huygens has continuously explored Saturn and its satellite system from 2004 to 2017 [1]. We analyzed data returned from VIMS (Visible and Infrared Mapping Spectrometer) [2], (spectral range 0.35 – 5.1 μm) to perform a disk-resolved surface composition study of Saturn's icy moon Dione. This regular moon is characterized by numerous craters varying in size and depth (the larger are Creusa and Diomedes), and wispy terrains, i.e., long, bright, and linear streaks that crisscross the surface on the trailing hemisphere. In performing our investigation, we take advantage of photometrically corrected spectral maps (Figure 1) derived from VIMS data by [3], which allow us to establish relationships between the surface composition with morphological features and endogenic and exogenic processes altering the satellites' surface properties.

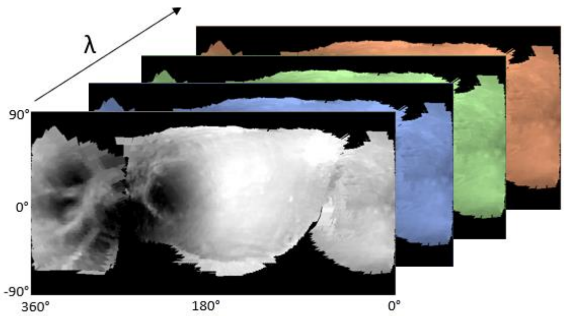

Figure 1: schematic representation of a spectral map of Dione from VIMS' data, in cylindrical projection. The surface is sampled with 720x360 pixels (0.5°x0.5° bins in the longitude-latitude grid). For each pixel of the spectral map, a VIMS spectrum of the surface is available.

Model: We have conducted a quantitative evaluation of the physical/compositional parameters that determine the spectral properties of Dione's surface. To accomplish this, we reproduced the spectrum of each bin in the spectral map by means of radiative transfer modeling (Hapke theory [4]). The average spectrum of Dione (Figure 2) indicates a surface dominated by water ice grains with the main absorption bands at 1.5, 2, 3 and 4.5 μm. The steep reduction of the reflectance at wavelengths shorter than 0.5 μm indicates the presence of a non-icy UV absorber and a possible presence of additional darkening material(s) is suggested by the observed albedo variability across the surface [5]. Starting from this evidence, we model the spectrum of Dione across the surface as an intimate mixing ("salt and pepper") of water ice grains embedding tholin [6] (as UV absorber) and carbon grains (as darkening material). To compute the optical properties of these endmembers we adopt the optical constants of water ice from [5,7,8], of amorphous carbon from [9], and of tholin from [10,11]. The best-fit selection is performed using a Levenberg-Marquardt least-squares algorithm.

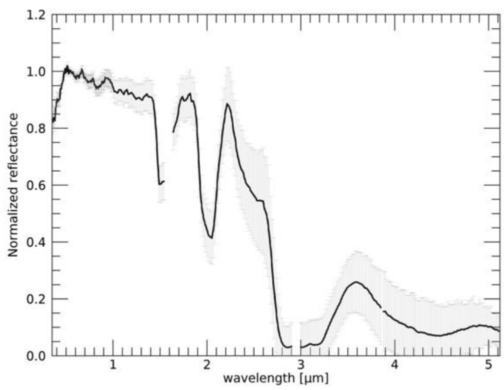

Figure 2: Dione's average reflectance spectrum normalized at 550 nm from VIMS observations. The error bars indicate the spectral variability on the surface.

Preliminary Results: Thanks to this method we can characterize the surface distribution of water ice and contaminants and the regolith grain size.

In Figure 3 we show a preliminary compositional map highlighting the surface dichotomy characterizing Dione [12,13]. The brighter leading hemisphere (longitude between 0°-180°; Figure 4) hosts larger amounts of water ice with respect to the trailing hemisphere (longitude between 180°-360°), where the two proposed non-icy contaminants are more abundant. In the trailing hemisphere, areas with increased amounts of water ice occur in correspondence of the so-called "wispy terrain", i.e., cracks on the surface of Dione exposing fresher material (Figure 4).

We will discuss the inferred compositional variability in the context of the complex interplay of endogenous and exogenous processes affecting the surface chemical composition of Dione and the rest of Saturn's icy moons.

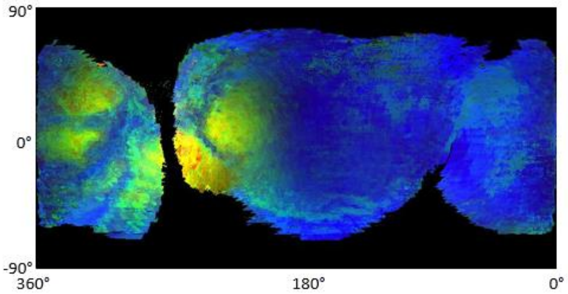

Figure 3: RGB compositional map of Dione showing the distribution of water ice (blue) and contaminants (tholin in red, carbon in green) across the surface.

Figure 4: Global, color mosaics of Saturn's moon Dione from Cassini Imaging Science Subsystem.

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